A NEW SPECIES OF *DENTALOPAGURUS* (CRUSTACEA: DECAPODA: ANOMURA) FROM DEEP WATERS OFF TAIWAN

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ABSTRACT

A new hermit crab species of the Paguridae, *Dentalopagurus rutilocinctus* sp. nov., is described from deep waters off Taiwan. The new species is closely allied to *Dentalopagurus levii* McLaughlin, 2007 in morphology and in choice of scaphopod shells as housing, but is distinguished by the armature on the carpus of the left cheliped, dactyli of the ambulatory legs, propodal rasp of the fourth pereopod, and the shape of the anterior lobe of the sixth thoracic sternite. The discovery of numerous specimens including females of the new species allows an emendation of the generic diagnosis of *Dentalopagurus*, which was known previously from only three males. The emended *Dentalopagurus* is more similar to *Michelopagurus* McLaughlin, 1997 than originally considered, with both sharing the characters of paired gonopores and paired first pleopods modified in females.

In a recent catalog of the hermit crabs of Taiwan, 133 species of 37 genera were reported from the island's waters (McLaughlin et al., 2007). Nevertheless, several likely new species collected by the ongoing deep-sea "TAIWAN" cruises since 2000 were not included in the catalog pending further study. Amongst the unidentified material is an unusual, scaphopod shell-dwelling species of the Paguridae from depths of 582–613 m off northeastern Taiwan. Careful examination has revealed that this species belongs to the recently described monotypic genus *Dentalopagurus* McLaughlin, 2007 that was based on three males from New Caledonia. However, the Taiwanese species differs from *Dentalopagurus levii* McLaughlin, 2007 in the armature on the pereopods and the shape of the anterior lobe of the sixth thoracic sternite. The Taiwanese taxon is herein described as new. Moreover, numerous specimens, including females of the new species, allow an emendation to the generic diagnosis of *Dentalopagurus*.

The type specimens are deposited in the National Taiwan Ocean University, Keelung (NTOU). The shield length, abbreviated as sl, is measured from the tip of the rostrum to the midpoint of the posterior margin of the shield. Terminology used in the description, for the most part, follows that of McLaughlin (2003), with the exceptions of numbering thoracic sternites, pleon for abdomen, and dactylus (dactyli) for dactyl (dactyls). The station (stn) designation CP refers to a 4 m French beam trawl.

Systematics

Family Paguridae Fabricius, 1775

Genus *Dentalopagurus* McLaughlin, 2007

Dentalopagurus McLaughlin, 2007: 508.

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Emended Diagnosis.—Eleven pairs of quadriserial phyllobranchiate gills. Rostrum distinctly triangular. Ocular peduncles moderately short, cornea not dilated; ocular acicles subtriangular, each with prominent submarginal or marginal spine. Antennal peduncle with supernumerary segmentation. Mandible with entirely calcified cutting edge. Maxillule with internal lobe bearing long seta. Maxilla with slender endopod. First maxilliped with slender exopod. Second maxilliped with elongate exopod. Third maxilliped with crista dentata moderately well developed, 1 or 2 accessory teeth. Sternite of third maxilliped (third thoracic sternite) with spinule on either side of narrow to broad V-shaped median concavity.

Chelipeds long, slender; right appreciably stouter, but not necessarily longer. Ambulatory legs generally similar; ventral margins of dactyli with corneous spines. Fourth pereopods weakly semichelate, propodal rasp with single or double row of scales on proximal half; no preungual process. Fifth pereopods chelate.

Males with short, stout right and left sexual tubes directed posteriorly; 4 unpaired, biramous left pleopods. Females with paired gonopores; first pleopods paired, modified; 4 unpaired biramous left pleopods. Pleon straight. Uropods symmetrical. Telson with transverse incisions; posterior lobes separated by median concavity, terminal margins each with 3–5 spines.

Species Included.—*Dentalopagurus levii* McLaughlin, 2007 (type species) and *Dentalopagurus rutilocinctus* new species.

Remarks.—The genus *Dentalopagurus* was recently established by McLaughlin (2007) on the basis of male specimens only. The discovery of another species including specimens of both sexes from Taiwan enables an emendation of the generic diagnosis, such as the shape of the endopod of the maxillule, length of the endopod of the maxilla, and armature on the propodal rasp of the fourth pereopod, in addition to female attributes. The new species from Taiwan is closely allied to *D. levii* in external morphology as well as the choice of scaphopod shells as housing. The paired gonopores and paired first pleopods modified in the females of *D. rutilocinctus,* new species, link *Dentalopagurus* more closely to *Michelopagurus* McLaughlin, 1997 than previously considered by McLaughlin (2007). Nevertheless, *Dentalopagurus* is still distinguished from *Michelopagurus* by the distinctly triangular rostrum, relatively long shield and presence of four unpaired left pleopods in males.

The relatively long shield is shared by some paguroid genera known to utilize scaphopod shells or polychaete tubes as carcinoecia, such as *Tomopaguroides* Balss, 1912 and *Enneophyllus* McLaughlin, 1997 (Paguridae), *Pylojacquesia* McLaughlin and Lemaitre, 2001 (Pylojacquesidae), and *Tsunogaipagurus* Osawa, 1995 (Parapaguridae). The xylicolous pagurid genus *Xylopagurus* A. Milne-Edwards, 1880 also has a distinctly long shield. The elongate shield may be an adaptation for cylindrical housing, although a distinctly long shield can be also found in the gastropod shell dweller; *Pagurus japonicus* (Stimpson, 1858) (Paguridae) and several species of *Calcinus* Dana, 1851, *Clibanarius* Dana, 1852, *Diogenes* Dana, 1851, and *Paguristes* Dana, 1951 (Diogenidae).

Dentalopagurus rutilocinctus new species

Type Material.—Holotype: NTOU A00835, male (sl 2.8 mm), TAIWAN 2006, stn CP371, 24°28.52′N, 122°12.83′E, 582–613 m, RV "Ocean Researcher I", 26 August

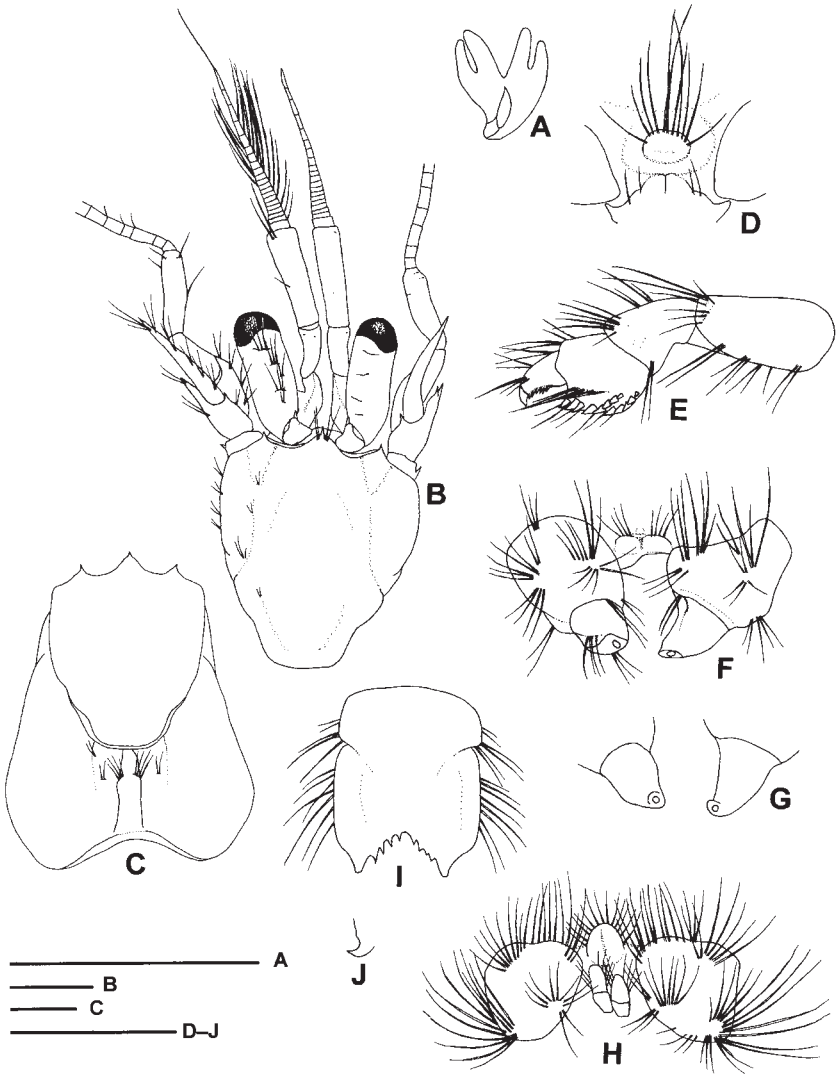

Figure 1. *Dentalopagurus rutilocinctus* new species; (A) paratype female (sl 2.5 mm), NTOU A00836; (B–G, I, J) holotype male (sl 2.8 mm), NTOU A00835; (H) paratype ovigerous female (sl 2.9 mm), NTOU A00836. (A) left arthrobranch on seventh thoracic sternite, proximal lamella; (B) shield and cephalic appendages, dorsal view (setae omitted from right side); (C) shield and posterior carapace, dorsal view; (D) sixth thoracic sternite, ventral view; (E) left fourth pereopod, lateral view; (F) coxae of fifth pereopods and eighth thoracic sternite, ventral view; (G) sexual tubes, anteroventral view; (H) coxae of fifth pereopods, eighth thoracic sternite, first pleopods, ventral view; (I) telson, dorsal view; (J) same, left posterolateral angle, lateral view. Scales equal 1.0 mm.

2006. Paratypes: NTOU A00836, 4 males (sl 2.4–2.9 mm), 2 females (sl 2.5, 2.6 mm), 6 ovigerous females (sl 2.2–3.7 mm), same data as holotype.

Description.—Eleven pairs of deeply quadriserial phyllobranchiate gills (Fig. 1A).

Shield (Fig. 1B,C) 1.2–1.3 times longer than broad; anterior margin between rostrum and lateral projections concave; anterolateral margin sloping, slightly concave; posterior margin roundly truncate; dorsal surface convex, with row of sparse short

setae laterally; lateral margins with scattered short setae. Rostrum distinctly overreaching lateral projections, triangular, with small marginal or submarginal spine and pair of short setae terminally. Lateral projections broadly subtriangular, each with small marginal or submarginal spine. Posterior carapace (Fig. 1C) generally membranous. Posterior carapace median plate calcified, narrow, contiguous with carapace lateral lobes; posteromedian and posterolateral plates moderately calcified in anterior halves; cardiac sulci each interrupted by short ridge bearing setae, but extending to posterior margin; sulci cardiobranchialis obsolete.

Ocular peduncles (Fig. 1B) short, 0.5–0.6 length of shield, not inflated basally, each with row of tufts of setae on dorsomesial surface; lateral surface slightly concave; corneas small, not dilated. Ocular acicles subtriangular, each with small marginal or submarginal spine distally, widely separated basally. Interocular lobe simple, clearly visible in dorsal view.

Antennular peduncles (Fig. 1B) when extended overreaching distal margins of corneas by entire lengths of ultimate segments. Ultimate segment distinctly longer than penultimate, broadened distally, with sparse setae. Penultimate segment without setae. Basal segment with small distal spine on lateral face of statocyst lobe. Dorsal flagellum longer than ultimate segment of peduncle; ventral flagellum approximately half length of dorsal flagellum, composed of 5–8 articles.

Antennal peduncles (Fig. 1B) when extended overreaching distal margins of corneas by 0.8–1.0 lengths of fifth segments. Fifth and fourth segments with scattered setae. Third segment with small spine at ventromesial distal angle; mesial face with scattered setae. Second segment with dorsolateral distal angle produced, reaching midlength of fourth segment, terminating in small, bifid spine; dorsomesial distal angle with small spine; mesial and lateral margins with sparse setae. First segment with small spine on lateral surface; ventromesial distal margin produced, with small spine. Antennal acicle long, reaching midlength of fifth segment of peduncle and overreaching distal margin of cornea, moderately arcuate, terminating in slender spine; mesial margin with row of tufts of short setae. Antennal flagellum overreaching tip of anteriorly extended right cheliped, with sparse short or very short setae on every article.

Mandible (Fig. 2A,B) with small, acute calcareous tooth at lower angle of cutting edge. Maxillule (Fig. 2C, endites shown separated) with subovate coxal endite; endopod with weakly produced internal lobe bearing bristle, external lobe strongly produced but not recurved. Maxilla (Fig. 2D, endites and scaphognathite shown separated, distal lobe of coxal endite missing) with comparatively narrow scaphognathite, endopod overreaching distal margin of scaphognathite. First maxilliped (Fig. 2E, endites shown separated) with endopod approximately 0.6 length of exopod. Second maxilliped (Fig. 2F) with comparatively slender exopod. Third maxilliped (Fig. 2G) moderately slender; carpus and merus unarmed; ischium with moderately well developed crista dentata composed of row of small corneous teeth and 1 or 2 accessory teeth; basis with 1 denticle on mesial margin; exopod nearly reaching distal margin of carpus.

Chelipeds (Fig. 3A–H) equal (smallest male, sl 2.4 mm; 2 females, sl 2.5, 2.6 mm) to somewhat unequal (large males) in length, with right cheliped (Fig. 3A–D) stronger and usually longer than left. Right chela elongate, 2.2–2.5 times longer than broad. Dactylus set at somewhat oblique angle to palm, 0.7–1.0 length of palm, terminating in small corneous claw; all surfaces unarmed but with scattered tufts of moderately

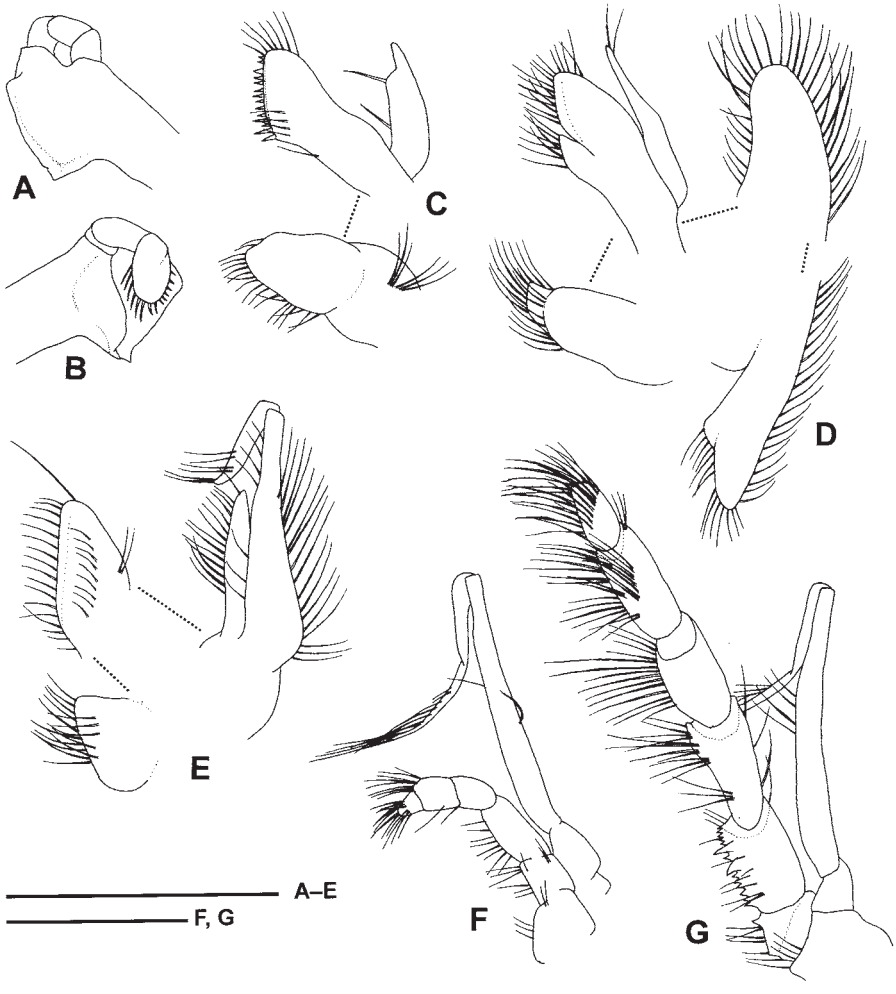

Figure 2. *Dentalopagurus rutilocinctus* new species, paratype female (sl 2.5 mm), NTOU A00836. (A) left mandible, ventral view; (B) same, dorsal view; (C) left maxillule, ventral view (endites shown separated); (D) left maxilla, ventral view (endites and scaphognathite shown separated, distal lobe of coxal endite missing); (E) left first maxilliped, ventral view (endites shown separated); (F) left second maxilliped, ventral view; (G) left third maxilliped, ventral view. Scales equal 1.0 mm.

long setae; cutting edge with 2 or 3 blunt calcareous teeth in proximal 0.7 and row of small corneous teeth on distal 0.3. Palm 0.7–1.0 length of carpus; all surfaces lacking spines but with scattered tufts of setae; dorsal and ventral surfaces convex; mesial and lateral surfaces with short granular ridges, more numerous on mesial surface. Fixed finger terminating in small corneous claw, with scattered tufts of setae on all surfaces, particularly dense on dorsal surface; cutting edge with 1 or 2 prominent blunt, calcareous teeth and distal short row of small corneous teeth. Carpus subequal in length to merus; dorsodistal margin with row of small tubercles and small mesial spine; dorsomesial margin with 1–3 small distal spines followed by row of short granular ridges or low protuberances, each bearing some setae; dorsolateral margin rounded or weakly delimited, unarmed; all surfaces with granules and short

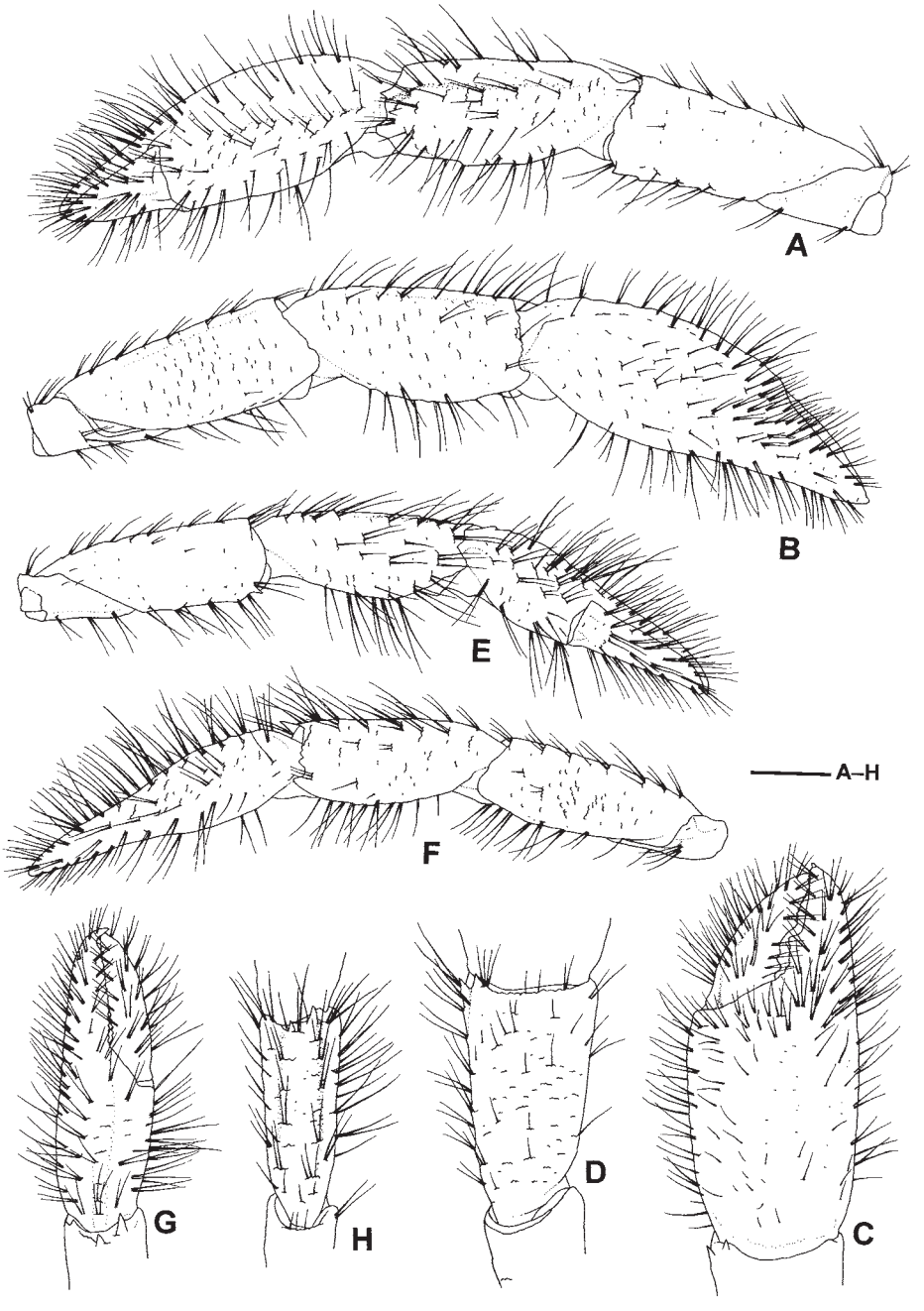

Figure 3. *Dentalopagurus rutilocinctus* new species, holotype male (sl 2.8 mm), NTOU A00835. (A) right cheliped, mesial view; (B) same, lateral view; (C) same, chela, dorsal view; (D) same, carpus, dorsal view; (E) left cheliped, mesial view; (F) same, lateral view; (G) same, chela, dorsal view; (H) same, carpus, dorsal view. Scales equal 1.0 mm.

granular ridges bearing some setae, ridges most numerous on dorsal surface; mesial surface somewhat flattened. Merus with row of granules on dorsodistal margin; dorsal surface with row of short ridges bearing sparse setae; mesial face nearly smooth, with sparse very short setae dorsally and longer setae ventrally; ventromesial margin with small distal spine; lateral surface with numerous, short to very short ridges and sparse very short setae; ventrolateral margin unarmed; ventral surface with some short ridges bearing sparse setae. Ischium nearly smooth, with sparse setae.

Left cheliped (Fig. 3E–H) reaching at least base of dactylus of right cheliped; propodal-carpal articulation slightly rotated. Chela elongate, 2.7–3.3 times longer than broad. Dactylus 1.2–1.4 times as long as palm, terminating in small corneous claw; all surfaces unarmed but with scattered tufts of short to moderately long setae. Palm 0.6 length of carpus; dorsolateral and dorsomesial margins rounded; all surfaces without spines but with granules or short granular ridges each bearing tuft of setae; dorsal surface proximally with weak, rounded crest of low protuberances, proximal protuberance with small spine or unarmed; cutting edge with row of small corneous teeth. Fixed finger terminating in small corneous claw; surfaces with scattered tufts of setae; cutting edge with widely-space, small calcareous teeth and row of very small corneous teeth in distal half. Carpus slightly shorter than merus; dorsolateral and dorsomesial margins each with distal spine followed by row of short granular ridges or low protuberances bearing some setae, protuberances of dorsomesial row blunt or subacute, distomesial spine much larger than distolateral; dorsal surface with few granules; lateral surface with short granular ridges bearing some setae; distolateral margin with row of small tubercles; ventral surface with sparse tufts of setae. Merus with row of granules on dorsodistal margin; dorsal surface with row of short ridges bearing sparse setae; mesial surface nearly smooth, with few very short setae; ventromesial margin with small distal spine; lateral surface with granules and short granular ridges as well as some very short setae; ventrolateral margin unarmed; ventral surface with short ridges bearing some setae. Ischium nearly smooth, with sparse setae.

Ambulatory legs (Fig. 4A–D) overreaching tip of right cheliped, similar from right to left, slender. Dactyli 1.4–1.7 times as long as propodi, slightly curved ventrally, each terminating in long corneous claw; lateral and mesial surfaces unarmed, with sparse short setae; dorsal surface slightly crenulate, with row of moderately long setae; ventral margin with 5–8 slender corneous spines and sparse tufts of setae. Propodi longer than carpi, not tapering distally, 3.6–4.5 times as long as high; lateral and mesial surfaces with scattered setae ventrally; dorsal and ventral faces with sparse long setae; ventrodistal angle with slender corneous spine. Carpi each with small dorsodistal spine; surfaces with sparse, short to moderately long setae. Meri slender, each with row of sparse setae on dorsal and ventral margins; ventrolateral distal angle with or without small blunt projection; lateral and ventral surfaces nearly smooth. Ischia unarmed, with sparse setae on dorsal and ventral margins.

Fourth pereopods (Fig. 1E) subequal or equal in size, similar from right to left; weakly semichelate; surfaces with scattered tufts of setae. Dactyli relatively broad, each terminating in blunt corneous claw, with row of closely-set, small corneous teeth on distal half of ventral margin; no preungual process. Propodal rasp extending beyond midlength of propodus, composed of partial double row of small corneous scales (short submarginal row present on proximal half). Carpi and meri unarmed.

Fifth pereopods chelate. Coxae (Fig. 1F,H) subequal or equal in size.

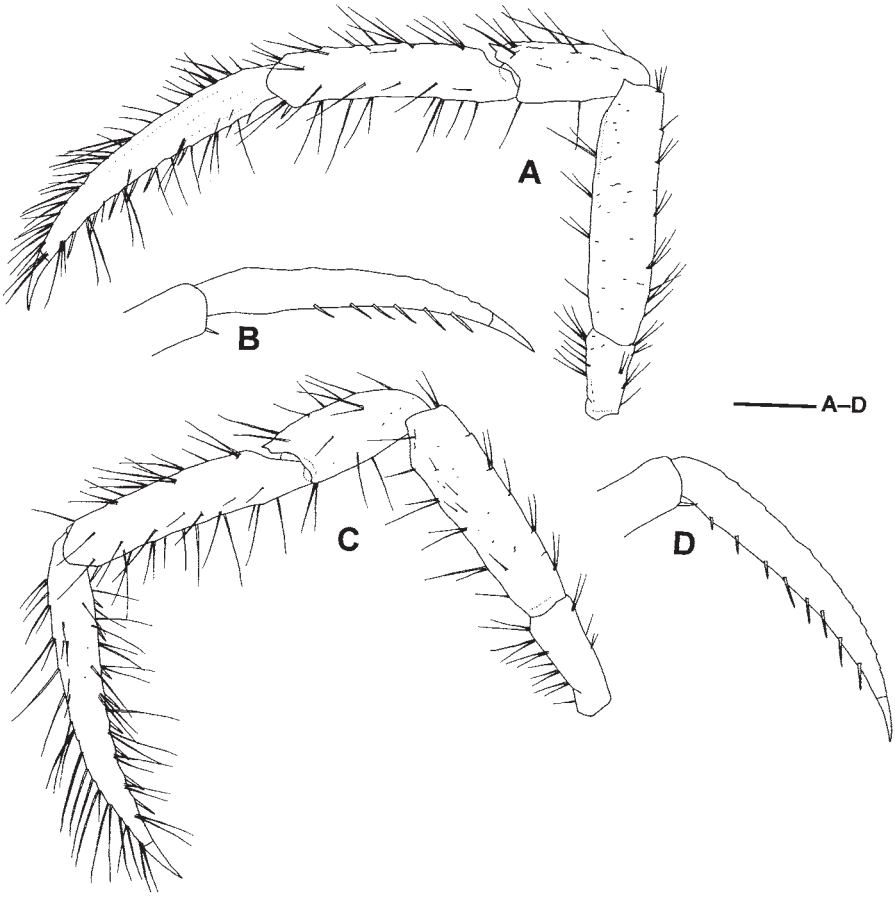

Figure 4. *Dentalopagurus rutilocinctus* new species, holotype male (sl 2.8 mm), NTOU A00835. (A) left second pereopod, lateral view; (B) same, dactylus, mesial view; (C) left third pereopod, lateral view; (D) same, dactylus, mesial view. Scales equal 1.0 mm.

Third thoracic sternite with pair of small spines separated by broad notch on anterior median margin. Sixth thoracic sternite (Fig. 1D) with subsemicircular, anterior lobe bearing moderately long setae on anterior surface. Eighth thoracic sternite (Fig. 1F,H) with pair of faintly separated, low lobes (males) or single rounded lobe with shallow median depression (females); anterior margin with row of short setae.

Males with paired sexual tubes (Fig. 1F,G); each tube shorter than width of coxa of fifth pereopod, directed posteroventrally, tapering and flattened distally, with blunt tip anteriorly curved. Females with paired gonopores.

Pleon well developed, nearly straight. Males with 4 unequally biramous, unpaired left pleopods, all with exopods moderately well developed, endopods less than half of exopods in length. Females with paired first pleopods (Fig. 1H) and 4 biramous, unpaired left pleopods; first pleopods short and flattened; second to fourth pleopods subequally biramous but fifth pleopod distinctly unequally biramous. Uropods symmetrical; endopods and exopods both with well developed rasps. Telson (Fig. 1I,J) with distinct transverse indentation on each lateral margin; posterior lobes symmetrical, separated by small median cleft; terminal margins oblique, each with row

Figure 5. *Dentalopagurus rutilocinctus* new species, paratype ovigerous female (sl 3.7 mm), NTOU A00836. Fresh specimen, dorsal view.

of 3 or 4 small spines; posterolateral angles each terminating in strong spine; lateral margins smooth but with row of setae, not chitinous.

Coloration (Fig. 5).—Shield, cephalic appendages, and pereopods generally white. Median part of shield slightly purplish. Posterior carapace with scattered reddish-orange dots. Corneas dark brown. Chelipeds and ambulatory legs with reddish-orange bands or blotches. Carpi of chelipeds each with band on proximal half; meri each with large blotch on median part of dorsal surface. Ambulatory propodi each with band or blotch on proximal halves of lateral and mesial surfaces; carpi also each with band or blotch on median parts of lateral and mesial surfaces; meri each with broad band on proximal 0.7. Eggs bluish-black.

Etymology.—From the combination of the Latin, *rutilus* (reddish) and *cinctus* (banded), in reference to the distinct red bands on the pereopods of this new species.

Remarks.—The new species closely resembles *D. levii*, but differs in having the carpus of the left cheliped with only a single spine at each dorsomesial and dorsolateral distal angle; the dactyli of the ambulatory legs armed with five to eight corneous spines on the ventral margins; the propodal rasp of the fourth pereopod composed of double row of scales on the proximal half; and the sixth thoracic sternite with a subsemicircular anterior lobe. In *D. levii*, the carpus of the left cheliped has a distinct row of small spines on each dorsomesial and dorsolateral margins, the dactyli of the ambulatory legs are armed with ten or eleven corneous spines on the ventral margins, the propodal rasp of the fourth pereopod possesses only a single row of scales, and the anterior lobe of the sixth thoracic sternite is subquadrate. In addition to these differences, the ambulatory legs (especially the meri) appear to be more elongate in the new species than *D. levii* (see McLaughlin, 2007, fig. 3A,D).

At present, *D. levii* and *D. rutilocinctus* new species are known only from deep waters of New Caledonia (675–700 m) and Taiwan (582–613 m), respectively. Two other scaphopod dwelling pagurids, *Tomopaguroides valdiviae* (Balss, 1911) and *Pagurus imafukui* McLaughlin and Konishi, 1994, have been recorded from both regions or from only Taiwan (McLaughlin, 2004; McLaughlin et al., 2007). These species can be readily distinguished from *Dentalopagurus* species by the markedly unequal chelipeds and lack of sexual tubes in males.

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